

PROJECT PROPOSAL

**GROUND- AND SURFACE-WATER AND
TAILINGS CHARACTERIZATION IN
THE SILVER CREEK TAILINGS AREA
OF PARK CITY, UTAH**

CONTENTS

	Page
Introduction	1
Problem	1
Objectives	3
Description of the site	4
Ground-water conditions	4
Occurrence of ground water and current concept of the flow system	5
Recharge	6
Precipitation	8
Seepage from Silver Creek	8
Subsurface inflow	8
Leakage from consolidated rocks	9
Movement	9
Discharge	10
Storage	10
Hydraulic properties	11
Ground-water quality	11
Surface-water conditions	12
Average flows	12
Surface-water quality	13

Work plan	14
Ground-water characterization	14
Drilling shallow observation wells	15
Drilling deep valley-fill observation well	19
Data collection	20
Water quality	20
Water levels	21
Surface-water characterization	23
Tailings characterization	25
Aquifer test	27
Reports	28
Work schedule	29
Summary of costs	33

ILLUSTRATIONS

	Page
Figure 1. Map showing location of Silver Creek Tailings Site	2
2. Generalized geologic section at Silver Creek Tailings Site	7
3. Map showing approximate locations of ground- and surface-water monitoring sites	16
4. Diagram showing generalized well completion	18

TABLES

Table 1. Analyses of dissolved metals, major ions, and total cyanide from ground- and surface-water samples	22
2. Analyses of total metals from surface-water samples	25
3. Analyses of metals from mine tailings and stream-sediment samples	28

INTRODUCTION

The Silver Creek Tailings Site is within the boundaries of Park City which is about 30 miles east of Salt Lake City, Utah (figure 1). The site is currently being investigated by the EPA and the Utah State Department of Health as a potential hazardous-waste site. The USGS, Water Resources Division, Utah District, has been asked by the Utah Department of Health to prepare a proposal, in cooperation with that office, to assist in determining if concentrations of constituents within the tailings and in ground water and surface water in the vicinity of the tailings exceed recommended limits. The following sections of this report contain information on the specific objectives of the study, an estimate of the ground- and surface-water conditions at the site, and a work plan outlining the approach, scope, time frame, and cost of the proposed study.

PROBLEM

A drilling program by the Utah Geological and Mineral Survey (UGMS) has identified high concentrations of arsenic, cadmium, mercury, and lead in the tailings. The Utah Department of Health collected and tested samples taken from the upper 2 inches of soil and from a depth of 12 inches below the ground surface. These samples confirmed the high concentrations of toxic elements found earlier in samples taken by the UGMS. Water samples from Silver Creek collected by the UGMS downstream from the tailings showed elevated levels of lead. Although levels of toxic elements are high, the potential hazard to residents is unknown.

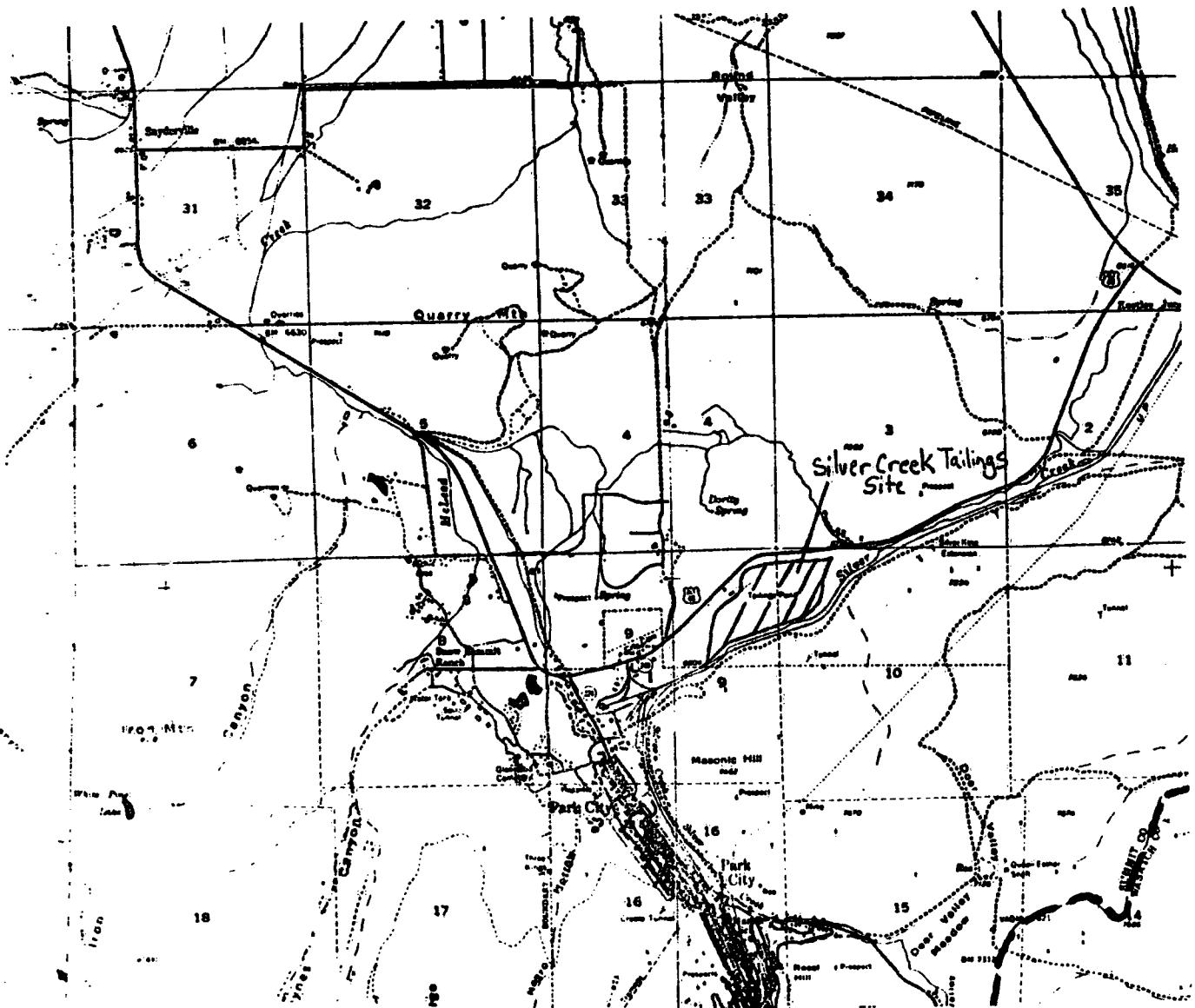


Figure 1.- Location of the Silver Creek Tailings Site.

OBJECTIVES

The objectives of the study are:

(1) To characterize the ground water, surface water, stream sediment, and tailings in the vicinity of the Silver Creek Tailings area. The results of the data collection and analyses will be used by the Utah Department of Health and the EPA to determine if contaminants are being released from the tailings to Silver Creek, or to the shallow or deep aquifers underlying the site.

(2) To prepare a detailed plan of study for a 2nd phase of this project if data from the first phase show a release, and the Utah Department of Health and EPA agree to a second phase.

The second phase, if needed, will include an aquifer test to assess the vertical and horizontal hydraulic properties of the unconsolidated- and consolidated-rock aquifers and the degree of connection that exists between them. The aquifer test will be conducted in the fall/winter of 1987 if the results of the first two series of samples collected at the observation wells indicates a need for a second phase.

The second phase of the study may also require the drilling of additional observation wells, geophysical surveys to determine depth of the fill, leaching studies, and modeling. The scope and extent of the second phase will be determined after initial data have been analyzed and the Utah Department of Health and EPA agree to the proposed study.

DESCRIPTION OF THE SITE

The site is located about one mile north of the main business district of Park City, Utah and is commonly referred to as Prospector Square. The site consists of a commercial development and residential community which has been built over mill tailings. These tailings are still exposed in some parts of the development, and vary in thickness from a few inches to a few feet (and may be thicker in local areas). The tailings consist of fine to medium grained sand and silty fine sand underlain by a thin (3.0 to 8.0 feet) soil mantle. Underlying the soil is a poorly sorted mixture of alluvial materials ranging in size from silt to cobbles.

GROUND-WATER CONDITIONS

A limited amount of ground-water data is available to describe the ground-water conditions at the site. A conceptual model based on available data can be used to describe the flow system until more data are available to substantiate or modify the original conceptual model. The following information is provided to aid in the development of a monitoring program and to indicate what parts of the ground-water system might play key roles in the area of the tailings.

OCCURRENCE OF GROUND WATER AND CURRENT CONCEPT OF THE FLOW SYSTEM

Ground water at the site occurs in unconsolidated valley fill and consolidated rocks. With the exception of a brief discussion of the occurrence of ground water in the consolidated rocks, the following discussion will deal primarily with ground water in the unconsolidated valley fill.

The unconsolidated deposits consist of poorly sorted cobbles, gravel, sand, silt, and clay of alluvial origin. The thickness of the unconsolidated valley fill at the site varies from a few feet near outcrops of consolidated rocks to at least 260 feet at the site of the Pacific Bridge Well on the western side of the site (figure 2). The depth to ground water in the unconsolidated valley fill varies from ground surface at the eastern side of the site to greater than 10 feet on the western side of the site.

The consolidated rocks in the area consist of, from oldest to youngest, the Park City Formation which crops out in the mountainous area immediately south of the site, the Woodside Shale which underlies the unconsolidated deposits at the site and crops out in the canyon immediately east of the site and on a small hill about one-half mile southwest of the site, and the Thaynes Formation which underlies the unconsolidated deposits north of the site and crops out on two small hills about one-half mile west and one-half mile northwest of the site and on a large hill northeast of the site. These formations dip to the north and strike approximately parallel to Silver Creek. Water levels in the Woodside Shale as measured in the Pacific Bridge well during 1983 and 1984 varied from about 6 feet above land surface to as much as 17 feet below land surface.

RECHARGE

Recharge to the unconsolidated deposits in the area of the tailings is probably from precipitation, seepage from Silver Creek, subsurface inflow from the west and northwest, and leakage from consolidated rocks.

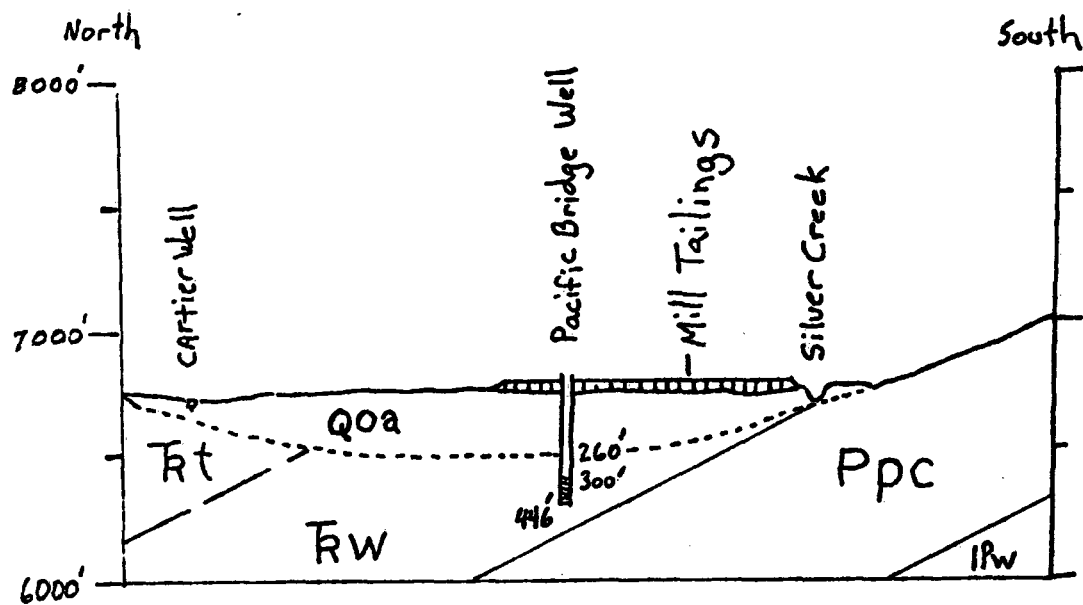


Figure 2.- Generalized geologic section
at Silver Creek tailing site.

Precipitation

Recharge from precipitation is probably small, but provides a mechanism for the movement of constituents from the tailings to the underlying unconsolidated valley fill. Most of the recharge probably occurs during the spring when the snow pack on the site melts and the ground thaws allowing infiltration of precipitation through the tailings to the unconsolidated valley fill. Data are not available to indicate the amount of precipitation that actually infiltrates to the unconsolidated valley fill.

Seepage from Silver Creek

Recharge from seepage from Silver Creek may occur in the upstream sections of Silver Creek where water levels in the unconsolidated deposits are probably below the elevation of the stream bed. Most of the recharge probably occurs during the spring months when the flow of Silver Creek is at a maximum. Seepage studies are not available to indicate the amount of recharge that may be occurring.

Subsurface Inflow

Recharge from subsurface inflow may occur along the western and northern sides of the site. The amount of recharge is dependent on the hydraulic gradient, horizontal hydraulic conductivity, and thickness of the unconsolidated valley fill. Data are not available to indicate the relative magnitude of recharge from subsurface inflow.

Leakage from Consolidated Rocks

Recharge from upward leakage from consolidated rocks may be occurring in the area of the site. The Pacific Bridge Well, located on the site, produces water from the Woodside Shale which underlies the tailings. Water levels measured in the Pacific Bridge Well during 1983 and 1984 indicate the potential for upward leakage, but the vertical permeabilities of the Woodside Shale and the unconsolidated valley fill are unknown.

MOVEMENT

Water in the unconsolidated valley fill probably moves under about the same general hydraulic gradient and direction as does water in the streams. Water in the unconsolidated valley fill at the west side of the site probably moves in an easterly direction while water at the northern side of the site probably moves in a southeasterly direction. Near the mouth of the canyon, just east of the site, the ground water may move toward and be discharged from two springs located at this site or into Silver Creek. Some water may move into the Park City Formation along the southern side of the site or move in an easterly direction through consolidated rocks on the eastern side of the site but data are not available to substantiate this contention.

DISCHARGE

Discharge from the valley fill underlying the site is probably to springs just east of the site, to Silver Creek in same general area as the springs, to drains that have been buried in the northeastern part of the site, or to a bed of permeable material placed around a sewer line that was buried in the area. The unconsolidated deposits pinch out in the canyon mouth which forces ground water to move to the surface and discharge and possibly to travel out of the site area through the coarse material placed around the sewer line. Some ground water may move to the east through consolidated rocks but data are not available to substantiate this contention.

STORAGE

The amount of water in storage in the valley fill deposits directly underlying the tailings depends on the porosity and volume of the deposits. The thickness of the deposits is about 260 feet at the Pacific Bridge Well but may be considerably thinner at other locations at the site. Data are not available on the porosity of the valley fill deposits.

HYDRAULIC PROPERTIES

Hydraulic properties of the valley fill at the site have not been determined. In the Parleys Park area, northwest of the site, the hydraulic conductivity of valley fill varied from 0.1 to 18 feet per day and averaged about 7 feet per day. The hydraulic conductivity of fill at a well, located about one-third of a mile northwest of the site, was estimated at about 60 feet per day based on a specific capacity of 9 gallons per minute per foot of drawdown reported by the driller. Thus, the hydraulic conductivity of the valley fill at the site may vary from 0.1 to 60 feet per day. The specific yield of the unconsolidated valley fill has not been measured.

GROUND-WATER QUALITY

Water-quality analyses of water samples from the unconsolidated deposits underlying the tailings are not available. Samples collected from the unconsolidated deposits in surrounding areas and reported in Technical Publication No. 85, Utah Department of Natural Resources, 1986, exceeded standards or recommended limits for cadmium, chloride, iron, manganese, sulfate, and dissolved solids.

SURFACE-WATER CONDITIONS

Two streams are located in the immediate vicinity of the tailings site. The Pace-Homer Ditch collects water from a series of ponds and drains located on the Park Meadows Golf Course northwest of the study area. In addition, water from Dorrity Spring and the Pace and Homer Spring areas discharges into the ditch and the combined flow of all these sources discharges into Silver Creek east of the tailings site.

Silver Creek heads in the mountains south of Park City where several perennial and intermittent streams, including those in Ontario and Empire Canyons and Deer Valley, contribute some flow. The creek flows past the tailings site on the south and eventually discharges into the Weber River near Wanship, Utah. Some storm drains may contribute flow to Silver Creek from urban areas during storms.

AVERAGE FLOWS

Measurements of discharge of the Pace-Homer Ditch are available in the Weber River Distribution System annual reports. A two-foot Parshall flume is located downstream from where the ditch crosses under the Park City-Heber City highway. The flume is only read during the summer months (May through September) and during normal years of average precipitation the discharge varies from about 3 to 6 cubic feet per second. During June and July of 1985, the discharge at the flume varied from 8.0 to 18.9 cubic feet per second due to a substained period of above normal precipitation. The long-term average discharge at the site is probably about 4 cubic feet per second.

Silver Creek, immediately south of the tailings, is dry during some times of the year. On August 3, 1979, during a study by the USGS, the creek was dry, but on May 14, 1980 the discharge was measured at about 5.5 cubic feet per second. The estimated average annual flow of Silver Creek at Park City is about 1 cubic foot per second (James Midgett, Park City Municipal Corp., oral commun., 1984).

SURFACE-WATER QUALITY

Water samples from the Pace-Homer Ditch and Silver Creek near the tailings have been collected and analyzed by the U.S. Geological Survey, Park City Municipal Corporation, and the Utah Geological and Mineral Survey. The results of the analyses show lead concentrations (total) in Silver Creek, at or near the tailings, to exceed State Primary Drinking Water Standards and one sample had a concentration of cadmium that exceeded the standard.

WORK PLAN

The work plan consists of steps needed to characterize the ground water and surface water at the site, and tailings encountered in boreholes. Water samples, sediment samples, and tailings samples will be analyzed by the Utah State Department of Health Laboratory in Salt Lake City. The U.S.G.S. plans to take splits of the samples for analysis by the U.S.G.S. Laboratories in Denver, Colorado.

The following sections describe the methods and procedures to be used during the study. The quality assurance program to be followed as part of this project is outlined in attachment A, the sampling plan is described in attachment B, and the health and safety plan is described in attachment C.

GROUND-WATER CHARACTERIZATION

The characterization of the ground-water system will include determining the quality of ground water and the direction of ground-water movement in the unconsolidated valley fill upgradient, beneath, and downgradient from the tailings site. To obtain the data necessary to characterize the system will require the drilling of 10 shallow wells and 1 deep alluvial observation well. Drilling will be done by the EPA designated Field Investigation Team (FIT). The data-collection program will include obtaining water samples for chemical analyses and measuring water levels in wells.

Drilling Shallow Observation Wells

It is proposed that 10 shallow (less than 50-foot deep) observation wells be drilled in the unconsolidated valley fill upgradient, on, and downgradient from the site. The presence of large cobbles under the tailings may not allow the use of a hollow-stem auger for completing the observation wells. The drilling may require air-rotary with a casing advancer to insure the proper completion of the observation wells. A USGS representative will be available at the site during the drilling operation. The following discussion is to be used as a guide in the drilling and completion of the observation wells. Actual completions ^{i.e. permeable zones, confining beds, tailing zone etc. no} may vary depending on individual site conditions.

Cuttings samples will be collected at 5-foot intervals during drilling to characterize fill underlying the site; except when tailings are encountered, where the tailings will be sampled with a split-spoon sampler at intervals of 2 feet (see section on tailings characterization). In addition, some split-spoon samples may be collected below the tailings to provide information on confining beds or other materials that may control the movement of water.

Proposed tentative locations for the observation wells are shown on figure 3. Final selection of the locations will be made after careful consideration of the impacts to the infrastructure (roads, utility lines, etc.) and residences of the community and the ability to gain permission to drill at these sites. Levels will be run to all observation wells to determine elevations of measuring points.

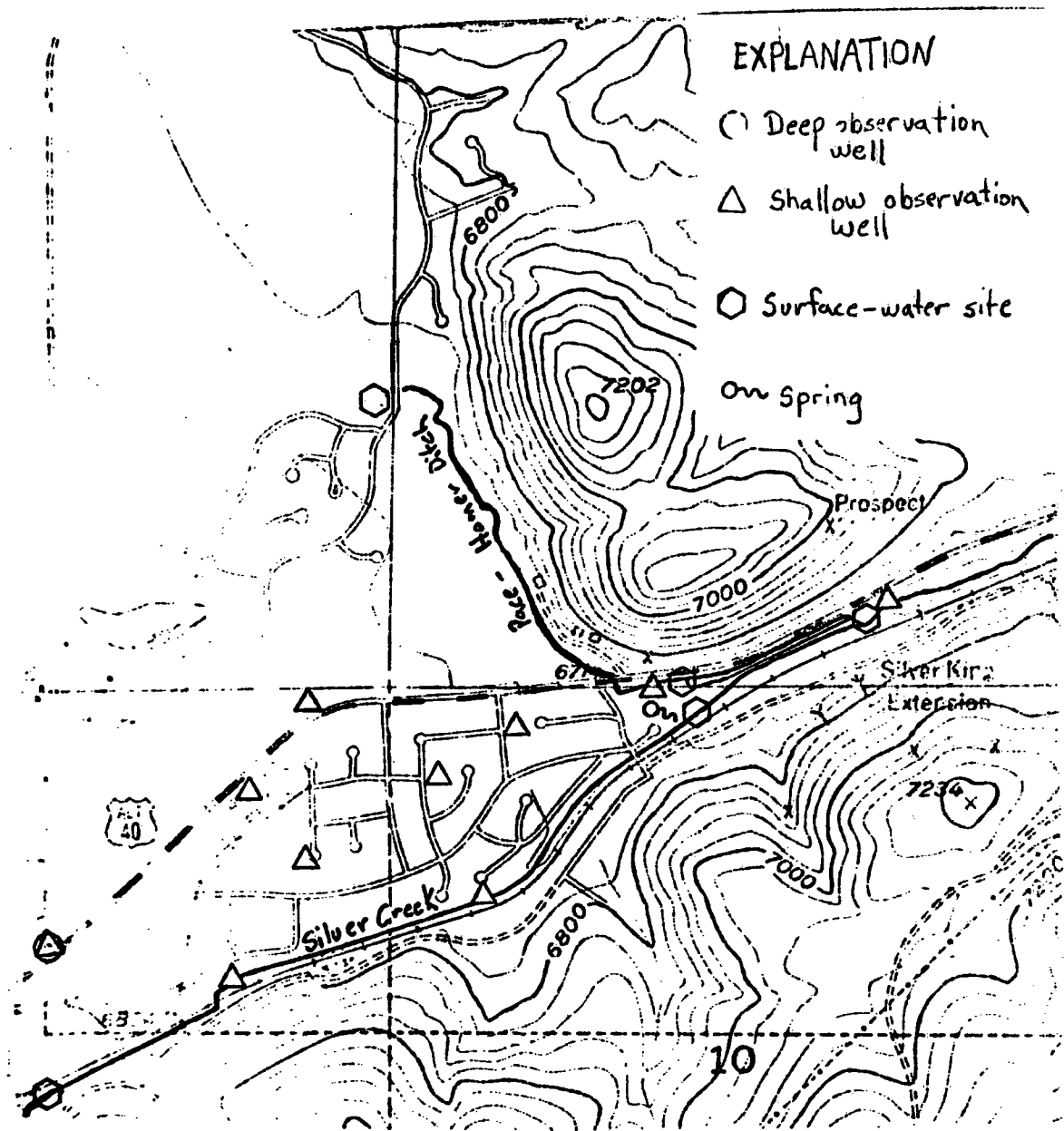


Figure 3.- Approximate locations of ground- and surface-water monitoring sites.

The method of drilling and completing the wells will consist of hollow-stem auger where subsurface conditions allow or air-rotary drilling using a casing advancer to a depth of between 10 and 15 feet below the water table, depending on the amount of water-level fluctuation anticipated at the location. In holes that penetrate the tailings, the tailings will be cased off and sealed with cement to a depth of about 5-feet below the tailings to prevent any contamination of the lower part of the hole. Two-inch (with the exception of any recorder wells which will be 4-inch casing), flush joint, PVC Schedule 80 casing, with a 5-foot, 20-slot well screen, and a 5-foot blank section at the bottom will be set in the hole. Silica sand, 10/20 grit, will be placed around the screen to about 2 feet above the screen. A 2-foot bentonite plug will be placed on top of the sand. A neat Portland cement/bentonite seal will extend from the bentonite seal to the surface and a locking steel jacket will be installed. All wells, when completed, will not extend above land surface.

The method of development, depending on the depth to water, may include centrifugal pumps, bailers, or nitrogen purging. Development will continue until the water is reasonably free of turbidity and the water temperature, pH, and specific conductance stabilize. Figure 4 shows a generalized well completion.

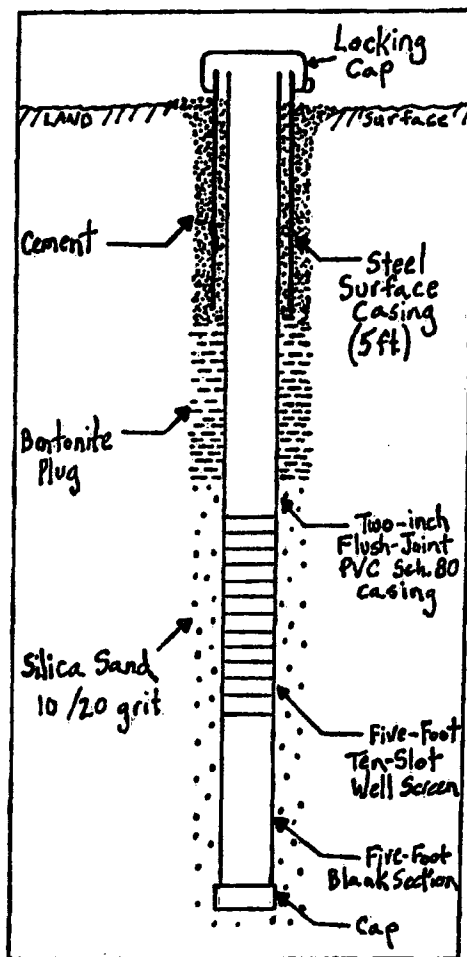


Figure 4.- Generalized well completion

change figure
to match language
on p. 17

Drilling Deep Valley-Fill Observation Well

It is proposed to drill and complete one deep observation well near the base of the unconsolidated valley fill, in a permeable zone, upgradient from the tailings at the site. The purpose of the well is to quantify quality of water moving into the fill at depth from upgradient. A large part of the recharge to the fill originates upgradient from the site. Numerous mining activities have occurred in the past in the upper parts of the Silver Creek drainage and since the area around the site is the primary discharge area for ground water in the unconsolidated valley fill in the upper part of the Silver Creek drainage, it is possible that water with elevated concentrations of metals from other sites upgradient could be moving into the fill underneath the site. Samples collected by Park City Municipal Corporation from Silver Creek upstream from the site had higher concentrations of metals than those samples collected from Silver Creek near the tailings.

The same well completion used in the shallow observation wells, including the PVC pipe, will be used to complete the deep observation well, with the exception of the method of placing the bentonite plug, where a conductor pipe will be used to slurry the bentonite down the hole. In addition, a 10-foot screen will be used in the deep hole. To gain additional information on the vertical distribution of hydraulic gradient and conductivity and water quality it is proposed to locate the deep observation well and a shallow observation well at the same site. The depth to the base of the unconsolidated valley fill may be about 260 feet. Cuttings samples will be collected at 5-foot intervals during the drilling. A USGS representative will be available at the site during drilling operations.

Data Collection

Data collection will include collecting water samples for chemical analysis and measuring water levels for a period of one year. The data collected over the one-year period will identify seasonal changes in water quality and water levels due to changes in recharge and discharge that occur during the year.

Water quality -- Water samples will be obtained from all wells on a quarterly basis with the exception of the spring months when monthly samples may be required due to rapid changes in water levels from increased recharge. The samples will be collected using suitable devices such as bladder pumps or bailers. Three casing volumes will be removed from the well before the sample is collected for analysis. Sampling and filtering devices will be cleaned between samples to avoid any cross contamination. The sampling plan to be followed during this study is described in attachment B.

The water-quality and physical parameters to be analyzed for in the field will include water temperature, specific conductance, alkalinity, and pH. The flow rate of the sampling device will also be measured. All equipment will be checked against standards before sampling occurs.

The water-quality constituents to be analyzed for, include major ions and trace metals, are listed in table 1. Only dissolved constituents will be determined. The proper sample containers and preservatives will be used in the sampling. The chain of custody forms and field notebooks required by the EPA will be used. The water level in each well will be measured prior to well evacuation.

In addition to sampling the observation wells, samples will also be collected from a spring discharging from the unconsolidated valley fill on the eastern side of the site, and from subsurface drains that are buried in the eastern and northeastern part of the site. It may be necessary to drill an additional well adjacent to the sewer line that leaves the area on the eastern side to determine the quality of the water in this area.

Water levels -- Water levels will be measured in the observation wells and the Pacific Bridge well on a monthly basis. In addition, at least one water-level recorder may be installed at an observation well to obtain water levels on an hourly basis. The recorder(s) will insure that data are collected on rapid water-level changes between monthly measurements.

Table 1
Analysis of Dissolved Metals, Major Ions and Total Cyanide
from Ground and Surface Water Samples
Utah State Health Laboratory

<u>Total Metal or Ion</u>	<u>Method</u>	<u>Method Number</u>	<u>Detection Limit</u>
Aluminum	AA, ICP	EPA 600/4-79-020-202.1 (200.7)	200.0 ug/L
Arsenic	AA, Hydride	EPA 600/4-79-020-206.3	1.1 ug/L
Barium	AA, ICP	EPA 600/4-79-020-208.1 (200.7)	10.0 ug/L
Beryllium	AA, ICP	EPA 600/4-79-020-210.2 (200.7)	5.0 ug/L
Cadmium	AA, Furnace	EPA 600/4-79-020-213.2	1.0 ug/L
Calcium	AA, ICP	EPA 600/4-79-020-215.1 (200.7)	1000.0 ug/L
Chromium	AA, Furnace	EPA 600/4-79-020-218.2	30.0 ug/L
Cobalt	AA, ICP	EPA 600/4-79-020-219.2 (200.7)	20.0 ug/L
Copper	AA, ICP	EPA 600/4-79-020-220.1 (200.7)	20.0 ug/L
Iron	AA, ICP	EPA 600/4-79-020-236.1 (200.7)	20.0 ug/L
Lead	AA, Furnace	EPA 600/4-79-020-239.2	10.0 ug/L
Magnesium	AA, ICP	EPA 600/4-79-020-242.1 (200.7)	1000.0 ug/L
Manganese	AA, ICP	EPA 600/4-79-020-243.1 (200.7)	10.0 ug/L
Mercury	Cold Vapor	EPA 600/4-79-020-245.1	0.2 ug/L
Nickel	AA, Furnace	EPA 600/4-79-020-249.2	1.0 ug/L
Potassium	Emission, ICP	Std. Meth. 16th Ed. 322B (200.7)	1000.0 ug/L
Selenium	AA, Hydride	EPA 600/4-79-020-270.3	0.5 ug/L
Silver	AA, Furnace	EPA 600/4-79-020-272.2	1.0 ug/L
Sodium	Emission, ICP	Std. Meth. 16th Ed. 325B (200.7)	1000.0 ug/L
Zinc	AA, ICP	EPA 600/4-79-020-289.1 (200.7)	20.0 ug/L
Alkalinity	Titrimeter	EPA 600/4-79-020-310.1	1000.0 ug/L
Chloride	Argento metric	Std. Meth. 16th Ed. 407A	1000.0 ug/L
Sulfate	Auto-MTB, ICP	EPA 600/4-79-020-375.2 (200.7)	10000.0 ug/L
Total Cyanide	Spectro Titrimetric	EPA 600/4-79-020-335.1	20.0 ug/L

SHL -- Techniques of Environmental Chemistry Section
Utah State Health Laboratory

MS/pw
0045z/14

SURFACE-WATER CHARACTERIZATION

The characterization of the surface water will include determining the quality of surface water above and below the tailings site. The data will be used to determine if water from the site is causing degradation of water quality in Silver Creek or if sediments may be transporting metals from the site. To obtain the data necessary will require establishing measuring and sampling sites on the Pace-Homer Ditch and Silver Creek both upstream and downstream from the tailings site. In addition, a site downstream from the confluence of the two streams to measure the combined flow and water quality will be established. Proposed surface-water measuring sites are shown on figure 3. In addition to the sites shown in figure 3, samples will be collected above, at, and below any storm drains that are discharging into Silver Creek, at, or downstream from the upper site on Silver Creek.

Water samples and discharge measurements will be obtained during high-, low-, and average flow conditions. Grab samples will probably be adequate because the streams are small. Water samples will be analyzed for both total and dissolved constituents. Field parameters will include temperature, specific conductance, alkalinity, pH, and eH. Proper sample preparation, preservation, and collection procedures will be used. Table 2 is a list of the parameters to be analyzed for at all surface-water sites. Discharge measurements will be obtained whenever a water sample is collected.

Table 2
Analysis of Total metals from Surface Water Samples
Utah State Health Laboratory

Total Metal or Ion	Method	Method Number	Detection Limit
Aluminum	AA, ICP	EPA 600/4-79-020-202.1 (200.7)	200.0 ug/L
Arsenic	AA, Hydride	EPA 600/4-79-020-206.3	1.1 ug/L
Barium	AA, ICP	EPA 600/4-79-020-208.1 (200.7)	10.0 ug/L
Beryllium	AA, ICP	EPA 600/4-79-020-210.2 (200.7)	5.0 ug/L
Cadmium	AA, Furnace	EPA 600/4-79-020-213.2	1.0 ug/L
Calcium	AA, ICP	EPA 600/4-79-020-215.1 (200.7)	1000.0 ug/L
Chromium	AA, Furnace	EPA 600/4-79-020-218.2	30.0 ug/L
Cobalt	AA, ICP	EPA 600/4-79-020-219.2 (200.7)	20.0 ug/L
Copper	AA, ICP	EPA 600/4-79-020-220.1 (200.7)	20.0 ug/L
Iron	AA, ICP	EPA 600/4-79-020-236.1 (200.7)	20.0 ug/L
Lead	AA, Furnace	EPA 600/4-79-020-239.2	10.0 ug/L
Magnesium	AA, ICP	EPA 600/4-79-020-242.1 (200.7)	1000.0 ug/L
Manganese	AA, ICP	EPA 600/4-79-020-243.1 (200.7)	10.0 ug/L
Mercury	Cold Vapor	EPA 600/4-79-020-245.1	0.2 ug/L
Nickel	AA, Furnace	EPA 600/4-79-020-249.2	1.0 ug/L
Potassium	Emission, ICP	Std. Meth. 16th Ed. 322B (200.7)	1000.0 ug/L
Selenium	AA, Hydride	EPA 600/4-79-020-270.3	0.5 ug/L
Silver	AA, Furnace	EPA 600/4-79-020-272.2	1.0 ug/L
Sodium	Emission, ICP	Std. Meth. 16th Ed. 325B (200.7)	1000.0 ug/L
Zinc	AA, ICP	EPA 600/4-79-020-289.1 (200.7)	20.0 ug/L

SHL -- Techniques of Environmental Chemistry Section
Utah State Health Laboratory

MS/pw
0045z/12

Sediment samples will be collected from the banks of the streams at the surface water-air contact at the same time the surface-water samples are collected at five sampling sites. Samples will be collected from each of the five sites during high-, average-, and low-flow conditions. The samples will be collected ^{at the water line} using a stainless-steel scoop and placed in 8-oz. glass jars. The sediment samples will be analyzed for the metals listed in table 3.

TAILINGS CHARACTERIZATION

The characterization of tailings encountered in boreholes will be used to help determine the areal and vertical distribution of metals in the tailings. Tailings will be sampled from about eight boreholes. Samples will be collected at 2-foot intervals using a split-spoon sampler. Strict decontamination procedures will be employed to avoid cross contamination with depth. The tailings samples will be analyzed for metals using inductively-coupled-plasma and wet- chemistry techniques as shown in table 3, or other EPA-approved methods. About 10 samples, selected at random, will be analyzed for CaCO_3 as a measure of the buffering capacity in the tailings. A lithologic log of the tailings will be recorded. ~~In addition, a soil sample for background information will be collected upgradient from the tailings.~~

Table 3
Analysis of Metals from Mine Tailings and Stream Sediment Samples
Utah State Health Laboratory.

<u>Metals</u>	<u>Detection Limit (ppm)</u>	<u>Laboratory Method</u>
Aluminum	20.0	ICP
Chromium	3.0	ICP
Barium	1.0	ICP
Cadmium	5.0	ICP
Cobalt	2.0	ICP
Copper	2.0	ICP
Iron	10.0	ICP
Lead	20.0	ICP
Nickel	6.0	ICP
Manganese	1.0	ICP
Silver	1.0	ICP
Zinc	2.0	ICP
Arsenic	0.2/50	Hydride/ ICP
Selenium	0.1/50	Hydride/ ICP
Mercury	0.02/50	Cold Vapor/ ICP

ICP -- Inductively Coupled Plasma

Note -- Sediment/soil samples will be analyzed on dry weight basis; 1.0 gram of sample will be used for digestion and will be diluted to 100.0 ml.

MS/pw
0045z/13

AQUIFER TEST

If the first two series of samples collected at the observation wells indicates a need for a second phase of the study, an aquifer test will be conducted to assess the vertical and horizontal hydraulic properties of the unconsolidated- and consolidated-rock aquifers and the degree of connection that exists between them. The scope and the extent of the aquifer test will be determined after initial data have been analyzed, and the Utah Department of Health and the EPA have agreed on the scope and nature of the aquifer test. It is proposed to conduct the aquifer test in the fall or winter of 1987-88.

REPORTS

Data collected during the study will be made available to all concerned parties as soon as it is collected and verified. Quarterly reports summarizing all of the field activities and analytical results will be furnished to the concerned parties. An interpretive report will be prepared which will include all data collected during the study and the interpretation of the ground-water and surface-water conditions at the site and in the tailings samples.

The report will include a potentiometric map showing the altitude of the water surface in the unconsolidated valley fill, maps showing the concentrations of dissolved metals in water samples from the valley fill, and tables providing data and information on the extent of the tailings encountered in the boreholes; the results of chemical analysis of tailings, ground water, and surface water; water levels; and test hole logs. Specifically, the concentrations of dissolved metals in ground water and surface water upgradient, within, and downgradient of the tailings site will be quantified. The text of the report will include a discussion of the ground- and surface-water conditions at the site and an estimated ground-water budget of the unconsolidated valley fill. The report will be published in the U.S. Geological Survey Water-Resources Investigations series.

WORK SCHEDULE

The work schedule for the project is listed below. Work on the Silver Creek Tailings Site is scheduled to begin on or about May 1, 1987. The following work schedule will be used to aid in the planning activity but the actual dates may vary depending on the completion dates of the observation wells, the seasonal fluctuations in streamflow and water levels in observation wells, and the availability of a production well for the purpose of an aquifer test.

- May 1-15 Locate and obtain permission to drill observation wells.
Locate surface-water monitoring sites.
- May 15-31 Drill and complete observation wells (contracted by the EPA).
Sample surface-water sites for high-flow samples.
- June 1-15 Measure water levels and collect water samples from all
observation wells.
- June 15-30 Run levels to all observation wells (including wells to be used
during aquifer test).
- July 1-15 Sample surface-water sites for average-flow samples.
Measure water levels in observation wells.
- July 15-31 Prepare quarterly report.
- Aug. 1-15 Measure water levels in observation wells.
- Aug. 15-31 Sample surface-water sites for low-flow samples.
- Sep. 1-15 Measure water levels and collect water samples from all
observation wells.
- Sep. 15-30 Design aquifer test by using radial-flow model.
- Oct. 1-15 Measure water levels in observation wells.

- Oct. 15-31** Collect background water levels on observation wells to be used during aquifer test.
- Prepare quarterly report.
- Nov. 1-15** Conduct aquifer test on Park Meadows Well.
- Measure water levels in observation wells.
- Nov. 15-30** Analyze aquifer test results.
- Prepare potentiometric map showing altitude of the water surface in the unconsolidated valley fill.
- Prepare maps showing concentrations of dissolved metals in samples from the valley fill.
- Dec. 1-15** Measure water levels and collect water samples from all observation wells.
- Dec. 15-31** Prepare tables showing data and information on the extent of the tailings encountered in boreholes; the results of chemical analysis of tailings, ground water, surface water; water levels; and test hole logs.
- Jan. 1** Prepare quarterly report which includes all basic data collected during the project.
- January thru June, 1988** Prepare a final report to be published in the U.S. Geological Survey Water-Resources Investigations series.

The proposed work schedule begins with locating drilling sites. Permission from land owners could require a substantial effort, and the assistance of Park City officials would help speed the process. Drilling at approved sites could begin before all locations are identified. The tailings samples will be collected and sent to the approved lab during the drilling operations. Water levels will be measured after the wells have been completed and water levels have recovered from the drilling operations, and continue on a monthly schedule. Water samples from ground-water sites (11 wells and one spring) will be collected during June, September, and December (schedule may vary due to maximum and minimum water levels).

Surface-water samples will be collected during high-flow, average-flow, and low-flow conditions. High flow on Silver Creek and the Pace-Homer Ditch occurs between April and June and low flow probably occurs in late summer or winter. Sediment samples will be collected at the same time as the water samples.

The work items listed above will require the cooperation of the Utah Department of Health, Division of Environmental Health, EPA, USGS, and Park City Municipal Corporation. Each agency involved will designate one person to act as the coordinator for that agency. Monthly technical meetings will be held to review progress and work out unforeseen problems that may be encountered.

The Utah Division of Environmental Health will be responsible for the overall coordination of the study, the analyses of the tailings and water samples, and the quality-assurance program for analytical work. The EPA, through its designated contractor, will be responsible for the drilling, completion, and development of the observation wells.

The location of drill sites, type of completion, and drilling and development procedures will be determined by mutual agreement of the U.S. Geological Survey and the EPA (or its contractor). The U.S. Geological Survey will assist the EPA in securing permission from landowners to drill. It is the responsibility of the driller to secure all necessary state permits.

The data-collection program will be the responsibility of the USGS and will adhere to EPA guidelines as determined by the Utah Division of Environmental Health. The final report will be written by the USGS and reviewed by the Utah Division of Environmental Health.

SUMMARY OF COSTS

ITEM ----	FY87 ----	FY88 ----	TOTAL -----
PERSONNEL			
Hydrologist, Project Supervisor (15 percent)	6,200	12,300	18,500
Hydrologist, Project Chief (100 percent)	26,600	53,400	80,000
Hydrologic Technician (25 percent)	4,600	9,200	13,800
ANALYSES OF WATER SAMPLES BY USGS LAB	9,200	--	9,200
ANALYSES OF SEDIMENT AND TAILINGS SAMPLES BY USGS LAB	2,600	--	2,600
VEHICLE COSTS	1,500	3,000	4,500
EQUIPMENT (RECORDERS, PUMPS, TAPES, ETC.)	15,400	--	15,400
COMPUTER COSTS	3,800	3,800	7,600
REPORT PROCESSING AND PRINTING	--	9,200	9,200
TOTAL	69,900	90,900	160,800

DISTRIBUTION OF COSTS

	FED FY87 ----	FED FY88 ----	TOTAL -----
UTAH DIVISION OF ENVIRONMENTAL HEALTH	34,950	45,450	80,400
U.S. GEOLOGICAL SURVEY, WRD	34,950	45,450	80,400
TOTAL	69,900	90,900	160,800

Doesn't include UBSHW costs for lab analyses.

\$24,000 on lab - state

+ Air